THE UNIVERSITY IN THE CLOUD COMPUTING

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Abstract

With the advancement of Information and Communication Technology ICT which favors increasingly fast, easy, and accessible communication for all and which can reach large groups of people, there have been changes, in recent years in our society that have modified the way we interact, communicate and transmit information. Access to this, it is possible, not only through computers situated in a fixed location, but new mobile devices make it available, wherever the user happens to be located. Now, information "travels" with the user. These forms of communication, transmission and access to information, have also affected the way to conceive and manage business. To these new forms of business that the Internet has brought, is now added the concept of companies in the Cloud Computing ClC. The ClC technology is based on the *supply and consumption of services on demand and pay per use*, and it gives a 180 degree turn to the business management concept. Small and large businesses may use the latest developments in ICT, to manage their organizations without the need for expensive investments in them. This will enable enterprises to focus more specifically within the scope of their business, leaving the ICT control to the experts. We believe that education can also and should benefit from these new philosophies. "*Due to the global economic crisis in general and each country in particular, economic cutbacks have come to most universities. These are seen in the need to raise tuition rates, which makes increasingly fewer students have the opportunity to pursue higher education".* In this paper we propose using ClC technologies in universities and we make a dissertation on the advantages that it can provide to both: universities and students. *For the universities*, we expose two focuses, *one*: "*to reorganize university ICT structures with the ClC philosophy*" and *the other one*, "to extend the offer of the university education with *education on demand*". *Regarding the former* we propose to use public or private Clouds, to reuse resources across the education community, to save costs on infrastructure investment, in upgrades and in maintenance of ICT, and paying only for what you use and with the ability to scale according to needs. *Regarding the latter*, we propose an *educational model in the ClC*, to increase the current university offerings, using *educational units* in the form of *low-cost services* and where students pay only for the units consumed on demand. For *the students,* they could study *at any* university in the world (virtually), from *anywhere*, without travel costs: money and time, and what is most important paying only for what they consume. We think that this proposal of *education on demand* may represent a great change in the current educational model, because strict registration deadlines disappear, and also the problem of economically disadvantaged students, who will not have to raise large amounts of money for an annual tuition. Also it will decrease the problem of loss of the money invested in an enrollment when the student dropout. In summary we think that this proposal is interesting for both, universities and students, we aim for "*Higher education from anywhere, with access from any mobile device, at any time, without requiring large investments for students, and with reuse and optimization of resources by universities. Cost by consumption and consumption by service".* We argue for a Universal University *"wisdom and knowledge accessible to all".*

Keywords: Educational model in the Cloud Computing, Education on demand, The University and the Cloud Computing, University courses on demand, Pay of university studies for use, Educational units in the form of low-cost services.

1 INTRODUCTION

The new information and communication technologies ICT are defined in [1] as the set resources, process and techniques used in the processing, storage and transmission of information. Within these ICT, we highlight in this paper the Virtualization and Cloud Computing. The Virtualization is the technology that enables, using software, to create multiple virtual versions of technological resources, on a single physical resource. For example, we can have virtual machines that emulate operating systems, and storage devices, or hardware platforms, etc. In [2] the virtualization is defined as an abstraction of computer resources called Hypervision (Virtual Machine Motor, VMM) which creates an abstraction layer between the hardware of the physical machine (host) and the operating system of

the machine virtual; this allows us to divide resources into one or more execution environments. This can virtualizes hardware, software, user sessions, etc. *Cloud computing* is a computing environment composed of multiple servers that have the ability to deploy virtual machines. These are used by users and can produce three types of services: Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). In general we talk of (XaaS) to determine "Everything as a Service". It involves obtaining all computing services that an organization or business need, through Internet and paying only for their use; for example, as we currently pay water or electricity that we consume in our homes. *The Cloud* is a resource provisioning model of ICT, which is offered as a service. It connects service providers and end users, who consume it. In the Cloud everything is connected. Users use resources provided for a Cloud provider like services, so users establish a connection to the provider's data center. This is transparent to users, who use what they need, regardless of anything else. It is *use on demand* including also *payment for use*. New roles of Cloud workers appear and should be: governed, managed, maintained, and updated, etc...; for ICT professionals. So, using Cloud technologies, companies and organizations can focus on their particular business without worrying about ICT, for which most of time they are not capacity neither in knowledge nor to invest, in them. In [3] authors make a very interesting study on the Cloud environment. They establish a comparison between the Intranet concept (private network based on Internet protocols) and Cloud Computing Network Architecture (web-based). They think that "*Cloud Computing is a new technological paradigm as old as intranets are*". They show the Cloud as an intranet model in which nobody knows where servers provide services and store data, are located. In addition they do a dissertation on advantages and disadvantages of Cloud, focusing also on the *payment per use*. As *advantages* they highlight: the lack of maintenance and control on the evolution and updating of software and hardware (for new versions, better capabilities, etc.); and the profitability in installations (since they can be used anywhere and at any time). As *disadvantages* they highlight that sometimes Cloud services are closed for updating or maintenance (this can be disastrous for companies that use the Cloud). These authors also consider the maturity and safety of Cloud, as an issue, highlighting responsibilities of suppliers and customers when there is a data theft. Who is responsible in the face of the truly disadvantaged, who are data owners? They speak of hot spots such as: access and data protection; on whose property of knowledge acquired is, when a company ceases to use a service, or it is removed; and they also speak on the lack of laws regulating the right on data. With these new technologies, new ways of understanding business, now there are third parties who have access to corporate data; these are service providers in the Cloud. So, we also ask ourselves, who is responsible when a data robbery occurs. Is it the company? Is it the provider? These questions are a cause of concern and research, by computer science researchers, such as the authors of [4] who, have performed a study on the legal aspects of Cloud, giving some guidelines and recommendations to consider in hiring their services. It tries to raise awareness in companies on legal aspects of *information security*, on the changes in policy and business processes, and the business organization, and especially to outsource the data storage; since the privacy, integrity and confidentiality of data can be compromised. Besides they deal with the problem of different government regulations of the countries in which we could negotiate. Which they have to take into account in terms of contracts, labor issues, criminal considerations, etc. In short this paper exposes the risks of hiring Cloud services for business security. Next we define some Cloud concepts.

1.1 **Service Types: SaaS, PaaS, IaaS.**

1.1.1 SaaS (Software as a Service)

It proposes the use of software applications as a service; these can be used without installing them locally on computers. It is no longer necessary to contract licenses for use, nor is software installation and maintenance required. These are acquired and used as a service and you pay only for what is consumed.

1.1.2 PaaS (Platform as a Service)

The use of platforms is proposed as a service, such as: operating systems, software tools that allow the installation of applications and Web services. These are environments configured for the deployment and development of custom applications, where all is transparent to the user, who does need to worry about installation or maintenance and administration.

1.1.3 IaaS (Infrastructure as a Service).

This type of service provides the Hardware as a service; that is, physical machines are not given but services that can provide specific hardware, and for this propose it will use virtualization technology.

The supplier of services provides the customers with a virtual data center where they can upload and execute their applications remotely. The physical machines such as: servers, computers, data storage devices, are at the supplier's premises; it is not known nor of interest to know where they are. The idea is to pay for consumption of resources used such as: disk space, CPU time, storage and data transfer, etc. Resources can be used by multiple users in a transparent and secure way, and in addition, it is possible to scale resources as needed.

1.2 Cloud types: Public, Private and Hybrid.

1.2.1 Public Cloud

In the public Cloud, users share public resources that a supplier provides via Internet, through IaaS, PaaS and SaaS services. The services may be free or paid for the time used.

1.2.2 Private Cloud

In a private Cloud resources are only used by an organization; these resources may be on outbuildings of a supplier or on premises of an organization. *In the former* a level of exclusivity and degree of isolation is decided, and even if the hiring of a virtual private network VPN is chosen; it allows a level of reliability as if the infrastructures were in the organization premises. There is also the possibility of hiring hardware infrastructure in exclusive dedication, which provides more security by taking advantage of the working philosophy in the Cloud. *In the latter* when an organization decides to keep hardware infrastructure on their premises, usually the access is restricted to the intranet of it.

1.2.3 Hybrid Cloud

This Cloud type is a mixture of the previous, which can use resources of both depending on organization needs. Organizations often hire public Cloud services to expand their own resources of a private Cloud, for example they can integrate a data center from the Cloud with own servers.

1.3 Virtualization

A basic technological concept used in Cloud computing is the *virtualization*, which is a technology that hides the physical characteristics of a computing platform from the users. *The virtualization* can create virtual versions of any technology resource, such as: hardware platforms, operating systems, storage devices, network resources, user sessions, applications, etc. *A virtual machine* VM allows us to have multiple virtual computers running on the same physical computer, in a way completely isolated and without interference between them. *A Virtual Machine Monitor* VMM also named hypervisor creates an abstraction layer between the hardware of a physical machine or operating system (host) and operating systems of virtual machines (guests). A VMM manages and orchestras the main resources of a computer in a dynamic way allocating these, among all virtual machines defined in the host computer. We can see this structure in Fig. 1.

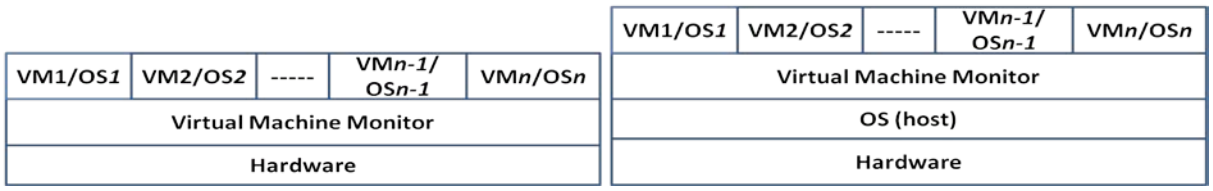

Figure 1. Example of *Virtual Machine Monitor* installed on hardware and on a host operating system.

The remainder of this paper is divided as follows: In Chapter 2 we reference several works on digital technologies applied in education and on the Cloud. In Chapter 3, we show our proposal. Finally, Chapter 4 presents conclusions and future research.

2 ART STATE

The Cloud is of great importance to new business opportunities that open; this allows separating the use of ICT, of the needs of business itself, which makes both the computing capabilities of the last few years, and the way of thinking about business management, difficult. The Cloud comes to alleviate the problem of organizations of requirements of investment in ICT, both maintenance and updating; as well as for new investments, in a rapidly changing and innovative computational environment is, otherwise so necessary and essential today. The new form of business based in *consumption of*

services on demand and *only paying for what is consumed*, lowers the cost and provides the ability to easily scale according to the needs of businesses and organizations. Several authors focus their research in the search for applications, which can be applied beneficially to Cloud philosophy. In [5] the authors analyze the Cloud architecture to include knowledge management systems, KMS on it, they highlight the importance to focus these systems more on the user and with a more social perspective; since due to cheaper technology and social changes, the number of users (consumers and producers) of Cloud products has increased. The work in [6] presents an overview of strategies of some of the leading providers in Cloud computing, such as Microsoft or Eucalyptus. It focuses on *private Cloud infrastructure* and proposes the best practices for the implementation and management of this type of Cloud and gives a series of recommendations to be considered when using this technology, such as: service level agreements, scalability, and licenses, etc. The authors propose this type of cloud as a solution to the lack of trust that *public Clouds* offer, since they can be managed by the organizations themselves. In [7] a comparative analysis of business opportunities in the Cloud for developed and developing countries, is performed, which provide a new way of understanding business; changing the concept of *investing in proprietary technology*, at the concept of *using the necessary technology without being the owner,* both in hardware and in software. The new Cloud philosophy for the development and enterprise management can affect other areas of society, for example also it can be used in the educational field in general and higher education in particular. The interest in the use of new technologies that the Internet offers to the educational process is not new. Young people use the Internet to find information, increasingly displacing textbooks in paper format. These new technologies applied in education are a new way of understanding teaching, and to make students became involved in the acquisition of their own knowledge. Several authors discuss digital technologies and their impact on new educational models in the near future. In [8] a study on virtual technologies used by young people is presented, underlining their interest in the search of information on the Internet, for immediate interest and benefit it in the long run, contributing to their training. They believe that teachers should use the benefits of these technologies to enhance the pleasure of *learning and research* in the requirements necessary for their training. They say that the teacher will cease be merely a "transmitter of knowledge" to become a supervisor and coach on Internet information that students obtain. The Internet educational offer has had enough booms in recent years and there are many proposals for development and improvement of online courses in all levels of education. In [9] the quality of *online courses* offered by United States universities it is analyzed. The authors emphasize the inexperience of teachers and organizations offering such courses. There is an absence of knowledge in *the pedagogy of online learning* and in the establishment of *best practices* on the design of such courses. This is compounded by the lack of culture of collaboration to share knowledge and best practices among institutions. Also the authors give a set of recommendations to alleviate these problems, establishing guidelines and methods to foster collaboration between universities, recommending "*aligning learning objectives with elements of course design*." The work in [10] shows a study on *e-portfolios*, which enable teachers to deliver lessons online. In addition it makes a dissertation on the advantages and disadvantages of preparing future teachers through *e-portfolio* and the benefit of this for students. Within Cloud technologies the authors in [11] analyze advantages that Cloud can bring in education, due to: scalability, processing power and low investment in the development of new educational projects. They consider the usefulness of the Cloud, they say "*We believe Cloud computing will surely improve the current system of education and improve quality at an affordable cost*". In [12] authors show a survey carried at to analyze the knowledge and readiness of secondary school teachers in Saudi Arabia, to use the Cloud. The survey reflects that teachers agree with the use of Cloud in education since regarding students: increases in their technical capacity, self-learning, and the collaboration with the teacher, preparing them also for working life, among other benefits. As disadvantages they include: Internet dependence, lack of security and confidentiality of data, and the complexity of management in the Cloud. In [13] an infrastructure and services model in Cloud for *e-education* is shown as a way to offer the scalability and reliability of educational software applications. The proposed model includes a learning management system and scientific research services; which is implemented in Ubuntu Enterprise Cloud UEC that is a driven environment by Eucalyptus software platform. This model consists of a set of services deployed in the Cloud which are used in various educational activities within the Department of E-Business, Faculty of Sciences of the Organization of Belgrade, where they are evaluated. The system evaluation is very positive highlighting the improvement in the *teaching / learning* process of both teacher and student. In [14] they propose using *Virtualization t*echnology having a unique hardware with multiple computing environments, thus saving costs and providing a variety of tools that enhance the training of students in general, and improving the training of ICT students in particular. They can remotely access a computing environment with high performance,

from their personal computers. This also allows increasing the scope of university resources. In [15] authors stress the need for computer science students to be trained in environments similar those used in real life, as it is usual in other disciplines. In ICT it is expensive to have virtual environments fully updated, because the speed with which they move, means that tools become quickly obsolete by both by the emergence of new tools, and by the appearance of new versions with a better performance. This means that sometimes students cannot be trained with the latest digital newness. Moreover, authors emphasize that students study in very limited scope and sometimes even share resources between different courses, providing a narrow view of tools and platforms. They emphasize *the security*, because it is difficult/dangerous to leave inexperienced students the control of ICT resources such as lab machines, user access control, network, etc. .., for this reason, simulated environments are often made; which are limited so as not to endanger the safety of university systems. And they also stress *the complexity of resource management*, having to configure platforms or environments of different courses and subjects, which means a lot of work for the technical team. To solve these problems, authors recommend the use of Cloud ICT, which will allow that universities and higher education organizations can use the latest technology without having to make large investments, and paying only for what they use and consume. Also they propose using *virtualization technology* as a new computing model for the *provision on demand* of virtualized computational resources, referring to the Amazon Elastic Compute Cloud as an example of this new paradigm. In summary this study proposes to unite two technologies: *Cloud computing* and *Virtualization*, to meet the needs of computer labs in universities and educational environments offering ICT and providing virtual computer labs on demand. In [16] a management model of trade relations between the university and students based in the Cloud is proposed, where the central subject is the student. The student can adapt and customize the system by his preferences. The proposed model is based on an educational website; which integrates the components of the *e-learning systems* such as: learning the management system, the management of information, the communication and collaboration tools, the reporting systems, and the social networking services, etc. This system uses both *Moodle* as a learning manager and *SugarCRM* as a relations manager among students. The work besides examines the teaching/learning process implemented in the proposed system and includes metrics for evaluating system performance and usage. In [17] a runtime environment for scientific applications on a Cloud is proposed, from two perspectives: *Deploying a Private Cloud* and *Configuring a Cluster using the virtual resources that Cloud offers*. In [18] the authors cover mobile devices to access the Cloud, solutions *here and now*, through the Cloud. They define *Mobile Cloud Computing* as "*availability of Cloud computing services in a mobile ecosystem*". It deals with of outsourcing computing and data stored outside of mobile devices, using them only to access /view results of the computation or data obtained like services on demand, from any place where the device is. In [19] the authors speak of sets of small clouds named cloudlets, which are closer to points of use or location and are wirelessly accessible via mobile devices. They propose to use them in the educational process, and in a model of connected school. The cloudlet characteristics proposed are: cheap device, small and with Internet connection, wireless interface, and a processor of multiple cores which is configured as a cloud and with minimal maintenance requirements. The aim is to create virtual machines for mobile clients and light as Smartphone or Tablets. These will connect wirelessly to cloudlet. As advantages they include: the processing power of the mobile device, the speed of connections, data loss that is not associated with the loss of the mobile device, and low maintenance cost, among other benefits. The disadvantage is especially the lower capacity, which makes it not valid when many users are connected. This proposal of a connected school, proposes to use the cloudlet, mainly for communication between students and teachers, and for its capacity to store educational resource repositories such as digital textbooks, and with easy access from mobile devices. They also propose to use the cloudlet in the educational process to use resources of a small cloud without Internet connection. In summary we found that ICT has much to contribute to education in general, and higher education in particular.

To the best of our knowledge we have not found a proposal equal to the approach discussed in this paper.

3 OUR PROPOSAL

Our proposal is to use ICT in higher education. Inside ICT, we investigate how to improve educational supply for universities from two approaches, *on one hand* we propose to reorganize structures ICT of faculties and departments within university, using Cloud philosophy; and *on the other hand* we propose to extend the university educational offer with *education on demand*, showing a new model for higher education using the Cloud. With this work we want to accomplish two main objectives, *first*

to save in ICT infrastructure and *second* extending the educational provision offered to students in higher education plans, such as degree, masters or graduate, under a new model that is "*request on demand and pay per use*". We explain this in the two following sections.

3.1- Proposal for Outsourcing of ICT Infrastructure by the Cloud

We begin by describing how the ICT structure of any University usually is. So far most of the universities are divided into centers; which are given specific and diverse teachings and where particular resources are used to supplement these. That is, each center has invested in its own ICT structure organizing its ICT resources as it considers appropriate. Centers use their own techniques of processing, storage and transmission of information; this is considered as a non centralized structure. Often there is also a centralized ICT structure which manages all the information regarding their Centers and students from across the University. This structure is typically located at the headquarters (Rectorate) where the management team of the University is located. Fig. 2 shows these structures.

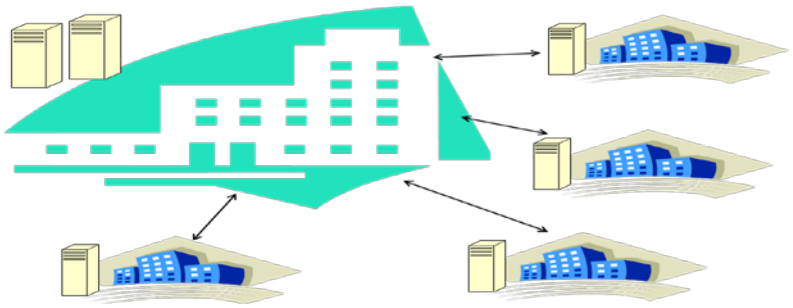

Figure 2: A CIT non centralized structure of university centers.

This situation involves a series of drawbacks because several centers use the same software resources but each pays its owner licenses. There are also centers where hardware resources are underutilized, while others have the need for more capacity than they have at certain times. The maintenance of these structures involves substantial ICT economic expenditure of budgets of Centers and Rectorate (the same thing is paid for several times). To alleviate these drawbacks we propose the use of the philosophy of Cloud computing, transforming ICT structures of these universities, so, we make up a study and analysis to choose the most appropriate type of cloud to the objective pursued. In Fig 3 we see the proposed structure, which is a centralized structure.

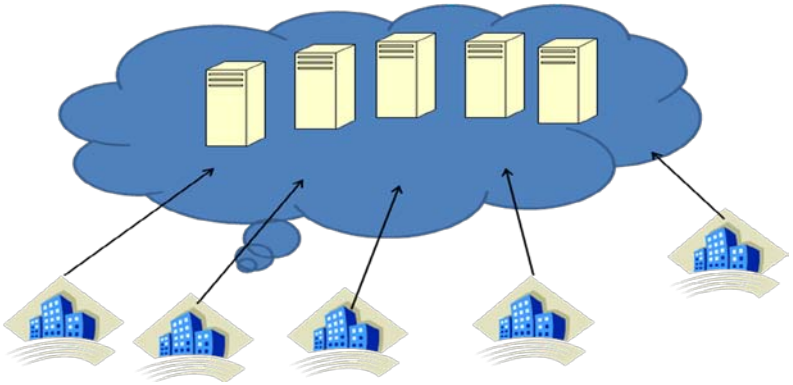

Figure 3: Centralized structure using Cloud computing proposed for university Centers.

To outsource within the Cloud all necessary resources for university management, both administrative and educational, we define some of the most important processes from the point of view of teaching. We can see these represented in Fig. 4.

3.1.1 Viability Study

It is necessary to make up a study and to obtain resources available that the University has. Here we check the capacity and antiquity of the same. With this it will be determined if it is of interest to use available resources or otherwise, request resources from a Cloud provider. In both situations resources are proposed using Infrastructure as a Service (IaaS). In any case we propose the externalization of the resource management.

3.1.2 Request of Courses on Offer for each Center

This process requests from each center the courses on offer of either: degree, masters or postgraduate, to know the educational provision offered by the University.

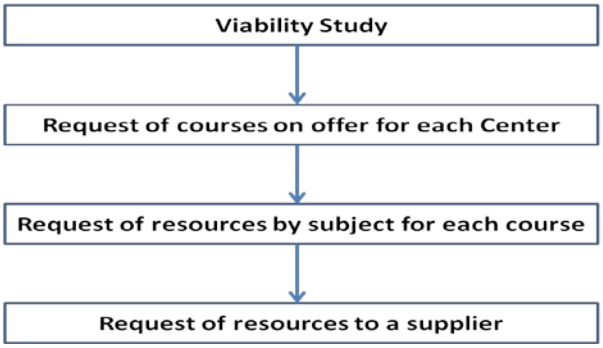

Figure 4: Some of most important processes to outsource the universities management to the Cloud

3.1.3 Request of Resources by Subject for each Course

Courses are divided into subjects, which are considered as *minimum educational units*. Each subject will have a content broken down into topics, which are also completed using a given resources set, of both software and hardware. This process also detects those resources that may be shared by several subjects.

3.1.4 Request of Resources to a Supplier

Once we have the information on resources that different subjects of different courses and Centers need, we request these resources from a particular supplier.

As a result of the above processes we will obtain *on the one hand* the choice of a model of *Private Cloud*, because the University as organization needs data protection; *on the other hand* we will obtain necessary and appropriate resources that must be outsourced in the Cloud. So, depending on the needs of each center we will use Infrastructure as a Service (IaaS); and different types of platforms as a service (PaaS); and software as a service (SaaS), which can be an open source, or specific and designed expressly for the university.

3.2 **Proposal of an Educational Model: Payment by Use**

The second of objectives in our proposal, and not least, is to expand the educational offering offered by the university to reach a greater number of students; this is beneficial for the university, and also for students. Some students, due to the rising price of higher education enrollments, have to abandon their studies; for this we propose the use of higher educational provision *on demand*, which makes it easy for students to take one or more subjects within a degree course, master or postgraduate, and paying only for its use. The student will only pay for what they use, and may pursue such studies as they deem appropriate. With this philosophy the educational provision at the University is extended, breaking down the barrier of space (anywhere in the world), and of time (24x7 availability at any moment) and also the economic barrier (affordable studios without restrictions of purchasing power of students). We will present a teaching model *of use on demand*, we specify how it is created and that procedures will follow to describe different online courses of degree, master and graduate, which is applicable to all university scope. The most relevant features offered by this model is *on the one hand*, as already mentioned, to expand the scope of higher studies increasing number of students, and *on the other hand*, enables the reuse of resources and sharing of knowledge by Centers. In Fig. 5, we see the proposed model with the most important processes that set the guidelines to follow for the development of educational provision of "*use on demand*, *pay per use*".

3.2.1 Creating the "Pay per Use" Management Application

This process will create a manager application named "*use on demand*, *pay per use*" which can be developed by the University or by a particular supplier. This application will allow establishing contents of each subject, and necessary activities, for students to develop skills which they must acquire when they finish to studying it; also credits associated with each subject must be included.

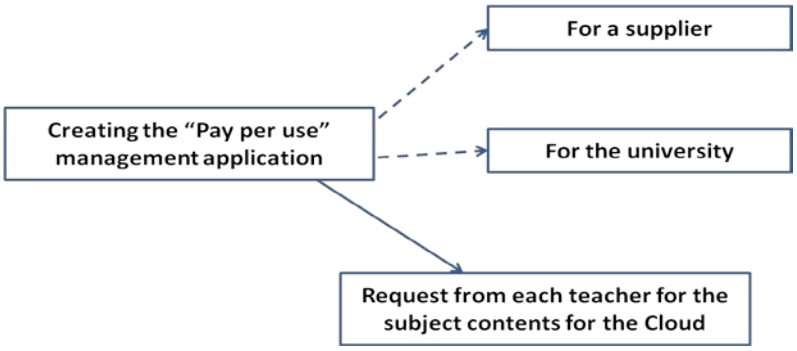

Figure 5: Processes model by educational provision of "*use on demand*, *pay per use*".

3.2.2 Request from each Teacher for the Subject Contents for the Cloud

This process shall enable each teacher to upload subject contents which he is responsible and indicating also how assessment of it is done; for example, we could use a learning manager such as the *Moodle*.

3.3 Functionalities that Students Must Get Out of the Manager Application

In Fig. 6, we can see some functionalities that the manager application must provide to students to use the educational offer "*on demand, pay per use*".

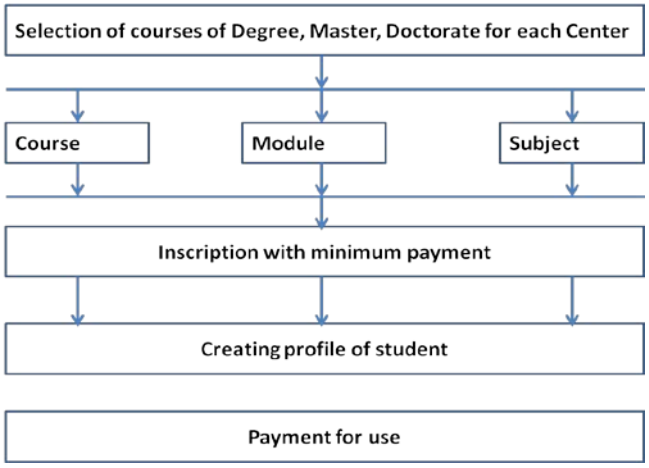

Figure 6: Processes model by educational offer "*on demand, pay per use".*

3.3.1 Selection of Courses of Degree, Master, Doctorate for each Center

As we saw in Fig. 5, the student may choose to study from courses of degree, master or doctorate, etc: a full course, which is composed of a set of subjects; a module, which corresponds to a set of interrelated subjects; or to take a particular subject.

3.3.2 Inscription with Minimum Payment

A minimum payment for registration of any of the modalities chosen in the previous process is proposed. This payment in some cases could be null.

3.3.3 Creating Profile of Student

This process creates a profile for a particular student and in addition offers access to educational provision in which it has registered. From this time the student will have their own virtual environment with subjects chosen.

3.3.4 Payment for Use

This process will allow the student to use the associated resources available in each subject by paying only for the use and time of use.

In summary we think that new Cloud technologies are destined to be of great importance in education training of the future and in particular in higher education.

4 CONCLUSIONS AND FUTURE WORKS

This paper shows a proposal to use Cloud Computer technologies in the educational offer for universities and higher education organisms, from two perspectives: *to reorganize ICT structures of universities with the Cloud philosophy,* and *to expand the university educational offer with education on demand and pay for use*. *The first, to reorganize ICT structures of universities with the Cloud philosophy,* proposes to use private Cloud, to reuse resources by the entire educational community such as: students, teachers and administrative staff, this way to save costs in investment of ICT infrastructure, and in upgrades and also in maintenance; paying only for what you use and the ability to scale resources by needs. *The second*, *to expand the university educational offer with education on demand and pay for use*, we believe it is possible to use ICT in Cloud by universities, to provide a educational offering that crosses barriers of space and time, by extending the higher education to all corners of the globe and without economic constraints.

We think that the university could be seen as a large provider of knowledge, providing online courses degrees, masters, PhD, etc..., by breaking down these in *minimum educational units*, elaborated in order to establish payment for them, cheap and affordable to a greater number of students, without restriction of place, time and money; and bringing the university closer to all. We speak about the type of private Cloud applied at university, with its own infrastructure or requested for a provider (to preserve privacy) and large servers, which would cover all its centers, providing easy to deploy virtual machines and easily deleted when no longer used. We advise that the resource management be outsourced using Cloud suppliers, saving in this way ICT cost of: investment, renovation and maintenance; which could result in lower tuition costs. Besides, providing a modern university, and always updated with the latest ICT. We go for the *Universal University* in the Cloud: "*Wisdom and knowledge accessible to all*", with the *acquisition of knowledge on demand, pay per use*. We believe that in this work the growing importance and potential of the Cloud has been reflected, in the bid for a better higher education.

Our future research is directed to implement a prototype to collect our proposal in order to establish an educational system in the Cloud, which allows us to consume *educational units on demand*, and with *pay only per their use and consumption*. We are also interested in analyzing the impact of using new Cloud ICTs in higher teaching, to reduce dropout by students.

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